Running title: Temperament and exercise dependence

Temperament and risk for exercise dependence: Results of a pilot study in female patients with eating disorders compared to elite athletes

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ABSTRACT

Background: The present pilot study investigated the relationship between temperament and the risk for exercise dependence (EXD). Sampling and methods: Thirty-two female patients with eating disorders (potentially at risk for secondary EXD) and 29 female elite athletes without eating disturbances (potentially at risk for primary EXD) answered the Eating Disorder Examination Questionnaire, the Exercise Dependence Scale - German version (EDS-G), the Behavioral Inhibition System / Behavioral Activation System Scales (BIS/BAS), and the Effortful Control subscale of the Adult Temperament Questionnaire (ATQ-EC). Results: There were significant positive correlations of the EDS-G with the BIS in women with an eating disorder and with the BAS in elite athletes. No significant association was found between the EDS-G and effortful control. Conclusions: The results indicate that the risk for EXD is associated with avoidance tendencies in women with eating disorders and with approach tendencies in elite athletes. Implications for secondary and primary EXD are discussed.

Keywords

Temperament, exercise dependence, eating disorders, elite athletes

Introduction

Exercise dependence (EXD) refers to a "seemingly unhealthy preoccupation with exercising" [1]. Criteria for EXD are based on the DSM-IV criteria for substance abuse and include the craving for physical activity that results in frequent exercising, withdrawal symptoms in the absence of exercise (e.g., irritability, mood swings), and interference with important obligations (e.g., work, family) due to extreme exercise [2-4]. Simply stated, individuals with EXD typically continue exercising despite exhaustion or serious physical impairment resulting from prolonged exercise [1].

Prevalence rates determined through questionnaire based methods suggest that about 3.5% of the adult population may be at risk for EXD [5,6]. However, prevalence estimates are substantially higher among those who regularly exercise or are professionally connected to sports such as clients of fitness rooms, sport science students, runners, or triathletes, ranging up to 30% and more [6-8].

Two distinct variants of EXD (i.e., primary and secondary) have been identified to differentiate the ultimate aim of exercising. According to Veale [4] "… in primary EXD, the exercise is an end in itself". Thus, any diet and weight loss that may occur as part of primary EXD is used to facilitate additional exercise and athletic performance goals. Individuals with primary EXD excessively engage in exercise and sports solely for the psychological gratification resulting from the activity itself. Therefore, primary EXD can be defined as presenting with EXD in the absence of an underlying eating disorder [4].

Conversely, individuals with secondary EXD use exercise as a compensatory behavior in attempt to lose weight, balance calories and to enhance physical appearance [9]. Hence, it can develop secondary to an eating disorder, and is usually associated with shape concerns, morbid fear of gaining weight, high levels of psychopathology (e.g., anxiety, depression) and

reduced health-related quality of life [10-15]. Excessive exercise is particularly prevalent among patients with the purging subtype of anorexia nervosa [15].

Prior research suggested a link between specific personality and temperament characteristics and EXD. Several studies specifically focused on secondary EXD and demonstrated that lower levels of novelty seeking [16] and higher levels of anxious-obsessional traits [15,17] were related to excessive exercising in individuals with eating disturbances. The association among personality and primary EXD suggests that different personality factors may explain this relationship. For example, Hausenblas and Giacobbi [18] found that non-athletic university students who reported higher scores on extraversion and neuroticism, and lower scores on agreeableness personality factors presented with primary EXD symptoms. Additionally, Grandi, Clementi, Guidi, Benassi and Tossani [19] reported higher levels of harm avoidance and persistence and lower levels of self-directedness in habitual exercisers with primary EXD.

Taken together, there is a lack of research exploring the difference between primary and secondary EXD with respect to personality or temperament. Thus, it is of particular interest whether primary and secondary EXD differ from each other in terms of underlying motivational and temperamental features, which may drive the EXD behavior. Temperament is understood as an early developing set of features linked to later personality [20]. According to Gray's [21] Reinforcement Sensitivity Theory, motivational factors can be viewed in terms of the following two neurobiological systems of reactive temperament: the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS). While the BIS is responsible for inhibiting an action when a particular behavior might lead to aversive, potentially punishing consequences, the BAS stimulates approach behavior in reaction to appetitive, rewarding stimuli [22]. High BIS sensitivity was previously linked to anxiety and depression and high BAS sensitivity to impulsivity [23]. Therefore, BIS and BAS perspectives are also likely to have value in differentiating EXD subtypes (i.e., primary vs.

secondary). Thus, it is unknown if the tendency toward excessive exercise reflects high levels of reactivity to aversive consequences (high BIS, avoidance tendency) and/or high levels of reactivity to appetitive, rewarding consequences (high BAS, approach tendency).

In addition to reactive temperament which is thought to operate in an automatic manner [24], theories of psychopathology propose that regulative temperament capacities that may control emotional reactivity [25]. In this way, effortful control is conceptualized to modulate problematic emotional reactivity that otherwise could lead to psychopathology [20]. Thus, it is possible that the level of effortful control differs between primary and secondary EXD.

The purpose of the current study was to explore the relationship between temperament and EXD in women that are considered to be potentially at risk for primary (e.g., elite athletes without eating disturbances) or secondary EXD(e.g., patients with a diagnosed eating disorder). Given previously reported gender differences with regard to sport specific patterns and psychopathology [19,26,27], only female participants were considered for the present study.

Based on prior research [9,15-17] our hypotheses were threefold. We hypothesized that 1) in patients with an eating disorder, symptoms of secondary EXD will be positively related to avoidance tendencies (high BIS). On the contrary, we 2) expected that in elite athletes, symptoms of primary EXD will be related to reward seeking and approach tendencies (high BAS). Taking into account previous findings about lower levels of self-directedness in habitual exercisers [19] we hypothesized that 3) EXD symptoms will be negatively related to effortful control in both groups.

Methods

Participants and Study Design

The study included two convenience samples of women who are considered to be potentially at risk for EXD: eating disorder patients (ED) and elite athletes (EA). Inclusion criteria were age ≥ 18 years and a minimum of at least one hour exercising per week. Exclusion criteria for the EA group were eating disturbances as measured with the Eating Disorder Examination-Questionnaire (EDE-Q) [28] (see below) to eliminate potential confounding effects of secondary EXD.

The ED group consisted of 32 female eating disorder patients. Twenty-two were recruited at a specialized eating disorder unit of a hospital and 10 at a supervised residential group for patients with eating disorders in Lower Saxony. Ten patients suffered from anorexia nervosa and the remaining 22 from bulimia nervosa. The patients engaged in jogging/walking/running (n = 11), fitness (n = 6), cycling (n = 6), swimming (n = 3), dancing (n = 3), ball games (n = 2), or horseback riding (n = 1). None of the patients performed sports on a competitive level. The assessments for the present investigation were conducted by an independent assessor (K.W.) who was not included in the treatment of these patients.

The EA group included 37 female athletes. Of those participants, 22 were recruited from the Olympic Training Center within the routine medical evaluations and 15 women were recruited at elite sports clubs before training sessions (1st and 2nd German Bundesliga) in Lower Saxony. The assessments were performed by an independent assessor (K.W.) who was not included in the medical evaluation or in the training. Eight women showed EDE-Q scores within the pathological range and they were therefore excluded from further analysis. The remaining EA group consisted of 29 female elite athletes (Olympic Training Center n = 15, German Bundesliga n = 14). Elite athletes from the Olympic Training Center were engaged in competitive dancing (n = 4), athletics (n = 4), sculling/canoeing (n = 4), boxing (n = 1), and water polo (n = 1). Athletes from the Bundesliga were training in ball games (n = 7), competitive dancing (n = 4), athletics (n = 2), or golf (n = 1).

After being informed about the aims of the study, all participants provided written informed consent. The research protocol was approved by the Institutional Ethics Committee of the Hannover Medical School. Data were collected between September 2012 and April 2013.

In addition, temperament results of these groups were compared to temperament data from an earlier study that had examined the psychometric properties of the German version of questionnaires assessing reactive and regulative temperament. The study was conducted in a large population-based sample (n = 1881) and has been described in detail elsewhere [28]. For the present study, we used data from a subgroup of the total sample, particularly from 171 women who were in the same age range as the participants of the ED and the EA group.

Assessment

The assessment included questions with regard to age, years of education, presence or absence of a partnership, weight, height, and hours exercising per week.

Eating disorder psychopathology was assessed using the German version of the EDE-Q [29]. For the current study the mean total EDE-Q score was used which showed a good internal consistency with Cronbach's $\alpha = 0.96$. A mean total EDE-Q score ≥ 2.3 indicates eating disturbances [29].

EXD symptoms were measured by using the total score of the German version [6] of the Exercise Dependence Scale-21 (EDS-G) [30]. The 21 items of the EDS-G assess key features of EXD and refer to the last three months (e.g. "I exercise to avoid feeling irritable." / "I exercise despite recurring physical problems." / "I am unable to reduce how long I exercise." / "I spend a lot of time exercising."). Cronbach's α for the total EDS-G score in the present sample was 0.89. A total EDS-G score above 77 was used to define individuals as "at risk for EXD" [6].

Reactive temperament was assessed by means of the Behavioral Inhibition System (BIS) and Behavioral Activation System (BAS) Scales (BIS/BAS) [32]. While the BIS scale (e.g., "I feel worried when I think I have done poorly at something important"; 7 items, α = 0.74) measures worry concerning potential punishment in the future and avoidance tendencies; the BAS scale (e.g., "When I get something I want, I feel excited and energized."; 13 items, α = 0.74) measures enthusiasm in the pursuit of potentially rewarding outcomes and approach tendencies. The BAS scale consists of the three subscales 'reward responsiveness', 'drive', and 'fun seeking'. Similarly to past studies, [33] the three subscales showed low internal consistency (e.g., 'reward responsiveness': α = .64, 'drive': α =.64, 'fun seeking': α =.35) and were therefore not used in the present study.

The 19-item Effortful Control subscale of the Adult Temperament Questionnaire-Short Form (ATQ-EC) [34] (e.g., "When I am trying to focus my attention, I am easily distracted", inversed; α = 0.72) was used to measure the extent to which high or low levels of effortful control (regulative temperament) generally characterize the person's interactions with the environment.

Data analysis

Data analyses were performed using IBM SPSS Statistics v.21. To calculate group differences, we performed nonparametric tests given that most variables were not normally distributed. Categorical variables were compared by using χ^2-tests. One-tailed Spearman's rank-order correlations were conducted to determine the relationship of excessive exercise (EDS-G) with hours exercising per week and with temperament features (BIS, BAS, ATQ-EC). The significance level for all tests was set at α = .05.

Results

Descriptive characteristics

All ED patients scored above the proposed EDE-Q cut-off for eating disturbances. The two groups did not differ with regard to age. ED patients were more often singles than elite athletes (87.5% vs. 31.0%, $p < .001$, respectively) and reported lower education compared to the EA group (≤ 12 school years: 37.5% vs. 13.8%, $p = .036$, respectively).

The ED group had an on average lower BMI and reported less hours exercising per week but did not differ from elite athletes with regard to the EDS-G (see Table 1). Nine ED patients (28.1%) and 3 elite athletes (10.3%) were at risk for EXD according to the proposed EDS-G cut-off criterion (Fisher's exact test $\chi^2_{(1)} = 3.04$, $p = .08$). In both groups, the EDS-G was significantly correlated with the number of hours exercising per week ($r_{ED} = .390$, $r_{EA} = .387$; $p < .01$).

The subgroup from the general population sample [28] did not differ from the ED and the EA group in terms of age (mean = 23.57; SD = 3.81) but had a higher BMI (mean = 22.98, SD = 4.35) than the two other groups ($F_{2, 229} = 13.41$, $p < .001$).

(Table 1)

Reactive and regulative temperament

Figure 1 presents the differences between the ED and the EA group with regard to temperamental features. In addition, both groups were compared with women from the general population. The ED group scored significantly higher on the BIS scale and lower on the BAS scale than the EA group. Moreover, the ED group exhibited lower effortful control (ATQ-EC). While elite athletes did not differ from the population-based sample, patients with

ED had lower effortful control and BAS but higher BIS scores than participants from the general population.

(Figure 1)

Relationship between temperament and excessive exercise by group

Table 2 presents the one-tailed Spearman's rank-order correlations between excessive exercise and temperament variables by group. The EDS-G was positively correlated with the BIS scale in the ED group and positively correlated with the BAS scale in the EA group. No additional correlations were found.

(Table 2)

Discussion

Taken together, the results of this pilot study support our first two hypotheses but not the third hypothesis. The main finding was that the link between risk for EXD and temperament differs by group. That is, higher EDS-G scores were positively correlated with higher BIS scores in women with an eating disorder (i.e. avoidance tendency) and were positively correlated with higher BAS scores in elite athletes (i.e. approach tendency). It is noteworthy that in both groups the EDS-G was not significantly associated with effortful control. Hence, at least in the present sample, our results suggest that different aspects of reactive temperament (BIS or BAS) but not regulative temperament (ATQ-EC) seem to underlie the risk for secondary or primary EXD.

The findings support earlier assumptions that inappropriately excessive exercise in patients with eating disturbances is mainly driven by negative reinforcement and that exercise serves as a maladaptive compensatory behavior to dealing with anxiety, depression, shape concerns and the intense fear to gaining weight [4,14,17]. By contrast, exercise in elite athletes may be linked to the ambition towards appetitive goals, fun and psychological gratification emerging from sports activity [4]. It is noteworthy that elite athletes exhibited effortful control and BIS/BAS levels that were not different from those in the general population. On the contrary, women with ED exhibited lower effortful control and lower reward sensitivity (BAS) but higher BIS levels than women from the general population (see Fig. 1). The latter result may have contributed to the aforementioned link between punishment sensitivity and the risk for EXD in ED patients.

Our findings should be interpreted in the context of some limitations. First, the groups were female convenience samples and were not matched by their sport activities. The results may therefore not be applicable for patients with eating disorders or for athletes in general. Moreover, no information was available with respect to response rates and selection bias. Second, given the small number of patients with anorexia nervosa (n = 10) we did not perform subsequent analyses by ED subgroups (i.e. anorexia vs. bulimia). Therefore, we cannot determine whether motor restlessness that is known as a consequence of starvation in anorectic patients contributed to high levels on the EDS-G [15]. Third, the sole use of questionnaires constitutes a shortcoming. Given earlier criticism regarding the potential overestimation of EXD using the EDS-G [31] there is some concern of whether the scale really assesses the propensity of EXD, particularly with respect to elite athletes. Intense exercise and intention effects of sport in this group were probably due to performance related reasons rather than psychopathology. Therefore, high EDS-G scores may have led to false positive diagnoses of EXD [31]. A closer look on the combination between reported hours of exercise per week and EDS-G means in the present study, however, revealed that despite that

elite athletes engaged in more hours per week in sports, they did not differ from the ED group with respect to their EDS-G scores. The rate of those who were at risk for EXD according to their EDS-G scores was higher in the ED group. Hence, we assume that the EDS-G measures more than just quantitative aspects of exercising that are typical in training and expected from an elite athlete to perform best. For example, several items of the EDS-G assess maladaptive affect regulation as a motivation for exercising (e.g., “I exercise to avoid feeling irritable.” / “I exercise to avoid feeling anxious.” / “I exercise to avoid feeling tense.”). Nevertheless, the clinical validity of high EDS-G scores in elite athletes remains questionable, which may have biased the results. Future research is encouraged to use an EXD measure that is validated in elite athletes and to add specific questions referring to motivations for exercise.

Taken together, our results should be considered preliminary and interpreted with caution. Although the conclusions are tentative, given the limitations mentioned above, the findings have clinical implications. Previous research has mainly focused on similarities among athletes and eating disordered individuals and correlated exercise with deleterious eating attitudes related to an eating disorder [35]. Thus, our findings extend the literature by identifying a temperament difference that may be important in the characterization of primary and secondary EXD. Interventions tailored at reducing inappropriately excessive exercise require a theoretical model [36]. Recognition of underlying temperamental features could be helpful in developing specific therapeutic approaches. Interventions focusing on anxious-obsessional and depressive traits may be reasonable in individuals with BIS driven EXD symptoms. Also, sport-therapeutic programs designed for patients with eating disturbances could help to use exercise in an appropriate, healthy manner [37]. The development or increase of adequate behaviors that are perceived as rewarding and giving psychological gratification may be helpful in individuals with BAS driven EXD symptoms.

In summary, our findings indicate an association between temperamental features and subtypes of EXD; driven by avoidance in ED patients and by approach in athletes. Future

research should address potential differences between ED subtypes and investigate more representative samples in order to verify and better understand the specific link between the risk for EXD and temperament suggested by the present outcomes.

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Table 1

Comparison of age, body mass index (BMI), hours exercising per week, eating disturbances and excessive exercise between groups

	Patients with eating disorders (n = 32)	**Elite athletes** (n = 29)		
	Mean (SD)	Mean (SD)	Mann-Whitney-U-test	p-value
Age	24.00 (5.99)	22.90 (4.55)	424.50	.566
BMI [kg/m^2]	19.29 (3.45)	20.67 (1.98)	264.50	.011
Hours exercising per week	5.02 (4.02)	12.83 (6.23)	116.00	< .001
EDE-Q	4.20 (0.98)	1.08 (0.60)	.00	< .001
EDS-G	62.17 (21.42)	62.73 (10.04)	458.50	.937

Note. EDE-Q – Eating Disorder Examination-Questionnaire, EDS-G – German Exercise Dependence Scale.

Table 2

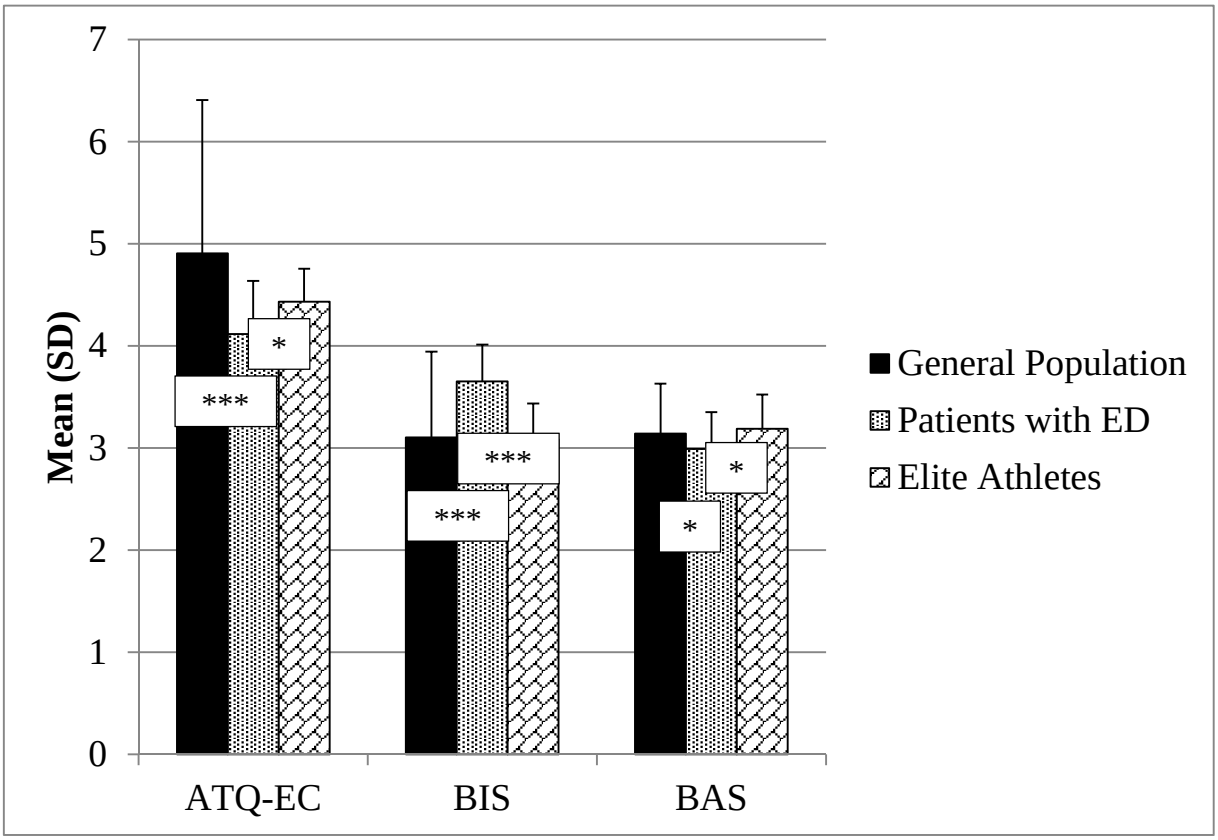
Correlations between risk for exercise dependence and temperamental aspects by group

Eating disorder patients				**Elite athletes**			
	ATQ-EC	BIS	BAS		ATQ-EC	BIS	BAS
EDS-G	-.11	.31*	-.04	EDS-G	.06	-.13	.46**
ATQ-EC	-	-.02	-.11	ATQ-EC	-	-.20	.09
BIS		-	.03	BIS		-	.08

Note. * p < .05, ** p < .01

Figure 1

Comparison of regulative and reactive temperament between female patients with eating disorders (ED, n = 32), female elite athletes (n = 29) and women from the general population (n = 171)



Note. ATQ-EC – Effortful Control Subscale of the Adult Temperament Questionnaire, BIS – Behavioral Inhibition System Scale, BAS – Behavioral Activations System Scale.
* $p < .05$, *** $p < .001$